

Technology for Improving Medication Monitoring in Nursing Homes

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Abstract

A 1997 report entitled *Prescription Drug Use in Nursing Homes*, by the Department of Health and Human Services' Office of the Inspector General, states that "patients may be experiencing unnecessary adverse medication reactions as a result of inadequate monitoring of medications." Of the preventable adverse drug events in nursing homes, 70 percent occurred at the monitoring stage of the medication use process. While clinical informatics systems have focused on the reduction of medication errors at the point of prescribing, dispensing, or administration, few have proposed the use of information technology in the monitoring stage of the medication use process. The authors describe a unique clinical tool for pharmacists and other health professionals—the Geriatric Risk Assessment MedGuide™ (GRAM™)—to reduce serious, preventable adverse drug events occurring during the monitoring stage of the medication use process. The authors focus on the prevention of delirium and falls, as these are two of the most common preventable adverse drug events in nursing homes. With the goal of preventing avoidable medication-related problems, GRAM identifies medications that may cause, aggravate, or contribute to common geriatric problems and facilitates the incorporation of medication-monitoring information in the care plan. Furthermore, the authors describe the real-time integration of the GRAM software with commercial pharmacy software, the development of reports for use in the nursing homes, the development and delivery of GRAM training for nursing facility staff, and early reports of acceptance of the software.

Introduction

There has been a dramatic change in the distribution of age in the general population, with elderly persons, particularly those over the age of 80 years, comprising an increasing proportion.¹ Both increased longevity and the increase in the number of elderly persons have contributed to expenditures for long-term care (LTC) increasing at an accelerated rate.² In the United States, approximately 21,000 LTC facilities provide care for more than 1.6 million people.³ Accompanying this rise in the elderly population is the increasing use of drug therapy in the management of chronic disease. In nursing homes, the typical resident uses an average of 6 different medications, and 20 percent use at least 10 different medications.⁴ Age-related changes in pharmacokinetics and pharmacodynamics⁵ and age-inappropriate drug selection^{6–8} can lead to complications in drug therapy, often manifested as an adverse drug event (ADE).

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The quality of care of nursing home residents has been a long-standing concern. The Nursing Home Reform Act, embedded in the Omnibus Reconciliation Act of 1987 (OBRA),⁹ required an unprecedented implementation of comprehensive geriatric assessment in Medicare- or Medicaid-certified nursing homes.^{10, 11} Improvements in the residents' safety and the quality of care provided¹⁰⁻¹³ and reduced hospitalizations resulted.¹⁴ Despite the impact of OBRA, a report entitled *Prescription Drug Use in Nursing Homes*,¹⁵ issued by the Department of Health and Human Services' Office of the Inspector General, recommends that Centers for Medicare and Medicaid Services (CMS) "should require pharmacists' direct input to achieving optimal clinical outcomes for residents." Despite this, medication-related problems that jeopardize patient safety are common in nursing homes.¹⁶ Gurwitz et al.¹⁷ estimated that ADEs occur in nursing homes at a rate of 1.89 per 100 resident-months, and that half of these events are preventable. Of all ADEs and potential ADEs, 1.39 per 100 resident-months are deemed fatal, life-threatening, or serious. Bootman et al.¹⁸ estimated that for every dollar spent on medications in nursing homes, two dollars are spent treating medication-related problems. ADEs occur despite the fact that CMS requires that the drug regimen of each resident be reviewed monthly by the pharmacist, that the pharmacist report any "irregularities" to the attending physician and director of nursing, that these reports be "acted on," and that each resident's drug regimen be "free of unnecessary drugs."

Clearly, improvements to pharmaceutical care delivery are required in nursing homes. Indeed, the use of clinical informatics and information technology affords great opportunities to promote patient safety in nursing homes. The medication use process includes prescribing, dispensing, administering, and monitoring. There are many clinical informatics systems available that focus on the reduction of medication errors at the point of prescribing (e.g., prevention of the wrong drug or dose); dispensing (e.g., medication bar coding, automated dispensing), or administering (e.g., use of scannable, bar-coded patient bracelets). Yet, few have proposed the use of information technology in the *monitoring* stage of the medication use process. Innovative tools targeting this stage of the medication use process are warranted, because of all preventable ADEs, 70 percent occur at the monitoring stage of medication use.¹⁷ For many of these events (more than 75 percent), the duration of symptoms lasted more than a day, indicating that prevention of ADEs may be possible through the effective detection of symptoms and interventions.

Funded through the Agency for Healthcare Research and Quality's (AHRQ's) Clinical Informatics to Promote Patient Safety (CLIPS) initiative, we are currently testing information technology developed by the American Society of Consultant Pharmacists (ASCP) Research and Education Foundation. The Geriatric Risk Assessment MedGuide™ (GRAM™) software¹⁹ specifically alerts prescribers and nursing facility staff to information that can reduce the threat to patient safety associated with ADEs. The GRAM software is intended to assist in the problem-identification process when evaluating complex medication regimens of older patients. With the goal of preventing avoidable medication-related problems, GRAM facilitates incorporation of medication monitoring information in the

patient's plan of care. The purpose of the current manuscript is to describe this unique clinical tool designed for use by pharmacists and other health professionals. In the context of our research project, we describe the successful completion of the pre-implementation phase of our research study. We describe the real-time integration of the GRAM software into commercial pharmacy software, the development of reports for use in nursing homes, the development and delivery of training for nursing facility staff, and early reports of acceptance of the software.

Comprehensive geriatric assessment process

The process of problem identification in nursing homes involves comprehensive geriatric assessment, decisionmaking, care planning, implementation, and evaluation. Unique to the nursing home setting is that comprehensive geriatric assessment is conducted under Federal mandate using the Resident Assessment Instrument's Minimum Data Set (MDS). The MDS is required for all residents in Medicare- and Medicaid-certified nursing facilities at predetermined intervals (e.g., at admission, quarterly, when significant changes in condition occur, and annually). The MDS focuses on care assessment and has more than 350 data elements covering cognitive function, physical function, continence, psychosocial well-being, mood state, disease diagnoses, health conditions, communication/hearing problems, nutritional status, oral/dental status, skin condition, special treatments, and medication use.²⁰⁻²³

MDS items identify residents who have specific problems or are at risk for developing them. Further evaluation via the Resident Assessment Protocols (RAPs) is "triggered" by the co-occurrence of MDS items. RAPs are structured, problem-oriented frameworks for organizing MDS and other clinically relevant, resident-specific information that identifies medical and functional problems. The RAPs form a basis for individualized care planning and help staff evaluate causal or contributing factors (some reversible) for the problem areas. Currently, there are 18 RAPs (Table 1). Medications can cause, aggravate, or contribute to most of the RAPs in this list. Table 1 highlights the RAPs targeted as part of the current patient safety research project, as well as RAPs covered by the GRAMTM software.

Geriatric Risk Assessment MedGuideTM (GRAMTM)

As innovators of pharmaceutical care delivery systems, in 1999 the ASCP Foundation developed and launched a product (MDS-Med GuideTM)²³ to assist health care professionals in identifying medications that may be associated with common geriatric problems, such as falls, delirium, and incontinence. In developing this unique tool, the ASCP Foundation focused not only on medications known to cause such conditions, but also included medications that could contribute to or exacerbate common geriatric problems. The idea was to provide a useful tool to correlate specific potential medication effects with signs,

Table 1. Resident Assessment Protocols (RAPs) targeted by GRAM™ and evaluated in the research study

Delirium*	Cognitive loss/dementia
Visual function	Communication
Activities of daily living	Incontinence
Psychosocial well-being†	Mood state
Behavior symptoms	Activities
Falls*	Nutritional status
Dehydration	Dental care
Feeding tubes†	Physical restraints†
Pressure ulcers	Psychotropic drug use

*RAPs targeted by the intervention.

† RAPs not included in GRAM™.

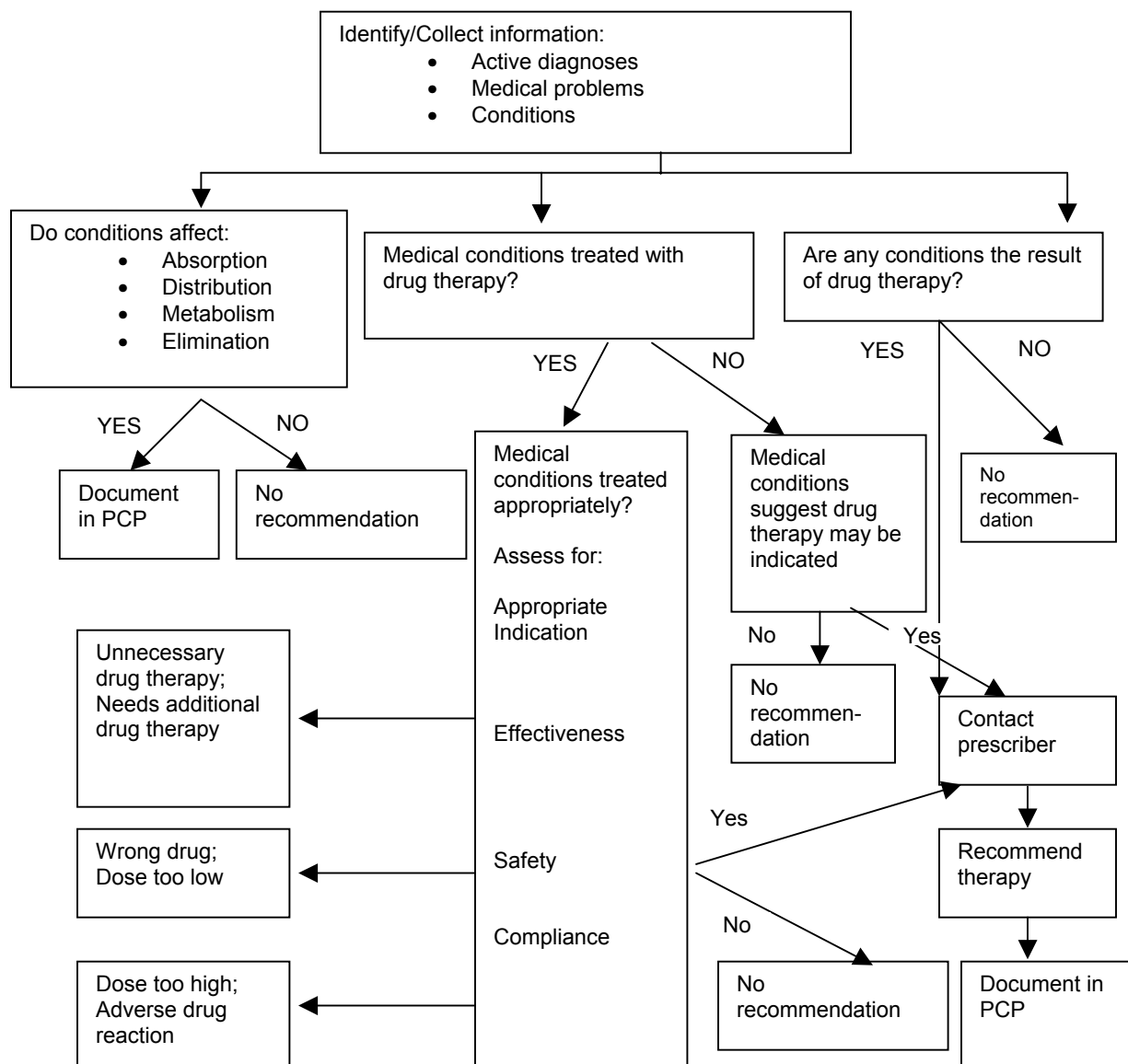
symptoms, syndromes, and indicators that describe mood, behavior, cognition, psychosocial well-being, and physical functioning. In the development phase of this product, the architects based their work on the federally-mandated MDS and RAPs discussed above.

In 2002, the ASCP Foundation released the Geriatric Risk Assessment MedGuide™ software (GRAM™-PC), an enhanced and computerized version of the MDS-Med Guide. This software was *not* designed to be a definitive reference for medication side effects and/or adverse drug effects. Therefore, it should not be used as a rigid screening tool, nor should it replace products specifically designed as definitive reference guides. Instead, the tool was designed to assist health care professionals with expertise in geriatric pharmacotherapy. The goal of the GRAM software is to assist in the implementation of the pharmaceutical care process (Figure 1).

The pharmaceutical care process includes assessment for

- *Appropriate therapy* (whether the patient is receiving unnecessary drugs or needs additional therapy for an untreated indication).
- *Effectiveness* (whether the patient is receiving the wrong drug or dosage form, whether contraindications are present, whether the patient is receiving the wrong dose or frequency of administration, whether there are drug interactions).
- *Safety* (whether a wrong dose or duration of therapy is used, whether there is an adverse drug reaction, whether the treatment includes an unsafe drug for the particular patient).
- *Compliance* (whether the drugs are correctly administered).

Figure 1. Pharmaceutical care process



The GRAM software can assist in the problem-identification and clinical-decisionmaking process when evaluating medication regimens of geriatric patients. The GRAM software facilitates the incorporation of patient assessment data in the monitoring of medication therapy. The GRAM software attempts to foster inclusion of medication monitoring into the patient's plan of care to proactively identify and prevent potential medication-related problems. Although the origins of the design of this tool are in nursing homes with the MDS and RAPs in mind, this clinical tool may be used by pharmacists or other health professionals in all settings of geriatric care.

Validity of GRAM software

The GRAM software is an evolving product, owing to the nature of the product and the goals that it seeks to achieve. The GRAM software requires updating to incorporate new knowledge as well as new medications. The algorithms driving the software must be updated periodically in response to (1) new information regarding the epidemiology of geriatric clinical syndromes and highly prevalent conditions afflicting geriatric populations, (2) new information regarding the beneficial and adverse medication effects in the elderly population, (3) new therapeutic indications for existing medications, and (4) the introduction of new medications to the market. A contract from the ASCP Foundation with the Duke University School of Nursing dictates the process of validation (both face and content) and revision of the clinical content of GRAM. The GRAM advisory board, an interdisciplinary group of health professionals with expertise in geriatrics and geriatric pharmacotherapy, provides guidance for the process.

The process that was developed for updating the drugs includes a reproducible process that uses FDA's Coding Symbols for a Thesaurus of Adverse Reaction Terms (COSTART) categories as well as review of the FDA pipeline. The FDA COSTART categories provide standard dictionary terminology to classify reported adverse events. The FDA pipeline includes drugs that are making their way through the FDA investigational and approval process. The process developed for updating the drugs in GRAM includes review of quantitative data on side effect occurrence from package insert information and pharmacology references. A board-certified geriatric clinical pharmacist reviews the package insert and pharmacology references for biological plausibility and reviews the difference between the side-effect incidences in active treatment groups versus groups receiving placebos.

The face and content validity is determined by an interdisciplinary panel of experts in geriatrics. Concerns regarding respondent burden resulted in the abandonment of applying the Delphi method to this validation process. The consensus panel approach was piloted, tested, and implemented for the correlation of adverse medication effects with geriatric problems.

Integration of GRAM into commercial pharmacy systems

During the first phase of the AHRQ-funded study, the ASCP Foundation identified a long-term care pharmacy provider willing to participate in the research study—Omnicare, Inc. Omnicare is the Nation's largest long-term care pharmacy provider with pharmacies in 43 States, serving 630,000 residents in skilled nursing facilities and assisted living communities. Two Omnicare long-term care pharmacies, Beeber Pharmacy, Englewood, Ohio, and Home Care Pharmacy, Cincinnati, Ohio, are participating in the study. GRAM was integrated into the pharmacies' commercial pharmacy software system and existing processes of pharmaceutical care delivery. We convened several meetings with all of the research partners to define the possibilities and develop a realistic, feasible strategy for implementing the intervention into the pharmacy operations. In the first phase of the project, the specifications of software changes required for full

integration of GRAM were defined by the research partners and integrated by the commercial software vendor.

The processes developed were presented to an advisory board consisting of geriatricians practicing in nursing homes, experienced nursing home nurses, consultant pharmacists at intervention sites, and leaders in the consultant pharmacy field. The advisory board provided guidance during the intervention development phase. Following is the intervention that was developed: For new admits/readmits, GRAM generates several reports in real time (as integrated with the commercial pharmacy software) for use by the consultant pharmacist and the nursing facility staff. These reports include a GRAM RAP-Med report, as well as Medication Monitoring Care Plans and Flow Records for falls and delirium. These reports are delivered to the MDS coordinator in the nursing homes Monday through Friday.

In addition, the consultant pharmacists receive GRAM RAP-Med reports for all of the patients who triggered the falls and/or delirium RAPs since the pharmacists' last visit to the facility. As part of the drug regimen review process, the consultant pharmacist evaluates the patient's medications for the potential to cause, aggravate, or contribute to falls and/or delirium; makes appropriate recommendations for monitoring or changes in therapy; and reviews these recommendations with the nursing staff.

The GRAM RAP-Med report is intended for use in the admission assessment process. A sample of a GRAM RAP-Med report is provided in Figure 2. The report identifies medications the patient is receiving that may cause, aggravate, or contribute to 15 RAP problems.

The Medication Monitoring Care Plans and Flow Records are generated for new patients who are receiving medications that may cause, aggravate, or contribute to falls and/or delirium. A sample of the Medication Monitoring Care Plan is provided in Figure 3. The Flow Records contain specific MDS items that may indicate adverse medication effects associated with falls and/or delirium. The goal of the Flow Record is to facilitate early recognition of signs and symptoms indicative of potential medication-related problems. Observation and charting is done by the nursing assistants; if symptoms are observed, the nursing assistants notify the nurse and chart the action. Through observation, documentation and action, the nursing assistant is an integral part of the success of this intervention.

Nursing home system change: integration of GRAM

The GRAM software is specifically designed to assist the consultant pharmacist to more effectively implement the pharmaceutical care process depicted in Figure 1. Although the GRAM software is equipped to provide feedback relating to 15 of the RAPs shown in Table 1, for initial integration of this clinical informatics tool into the nursing home setting, we focused on two

Figure 2. An example of a GRAM RAP-Med report

GRAM™ RAP-Med Report

Thursday, June 17, 2004

Resident: Test Patient
Facility: Nursing Facility
City/State: Alexandria, VA
Room/Apt. 310B

Primary Prescriber: John Emdee
Phone: 703-555-0000
Fax:

Prepared by: GRAM User
Company: ASCP



Allergies: Sulfa
Diagnoses: COPD
 Osteoarthritis
 Depression
 Hypercholesterolemia
 Hypertension
 Coronary Artery Disease

THIS REPORT SHOULD BE ACCOMPANIED BY AN EXPLANATORY MEMO AND RELEVANT RECOMMENDATIONS. This patient's medication regimen has been screened for its potential to cause, aggravate, or contribute to RAP problems using the Geriatric Risk Assessment Med Guide™ (GRAM™). GRAM™ DOES NOT ENCOMPASS ALL MEDICATIONS. GRAM™ screens only those medications commonly prescribed for older patients to treat common chronic diseases/conditions. Medications not included in GRAM™ will appear as "Medications Not Screened" on this report. Column 1: RAP number and name; Column 2: Medications screened that may cause, aggravate, or contribute to RAP problem; Column 3: RAP Triggers.

MEDICATIONS SCREENED

Medication	Dose/Route/Frequency	Prescriber
Advair Diskus	1 puff bid	John Emdee
Celebrex	200mg po qd	John Emdee
Combivent	Inhale 2 puffs bid	John Emdee
Ditropan	XL 10mg po qd	John Emdee
DSS	100mg po bid	John Emdee
Enulose	30cc (20gm) po qhs prn	John Emdee
Levothroid	125mcg po qd	John Emdee
Lipitor	40mg po qd	John Emdee
Plendil	ER 10mg po qd	John Emdee
Prevacid	30mg po qd	John Emdee
temazepam	30mg po qhs	John Emdee

GRAM™ RAP-Med Report

RAPs: falls and delirium. We did so because we believed that falls and delirium pose the largest threats to patient safety in the nursing home setting. One-third of preventable adverse drug events were neuropsychiatric (including delirium, hallucinations, and oversedation), and 20 percent were falls.¹⁷ In long-term care facilities, more than half of residents fall each year,²⁴ which contributes to further functional decline.²⁵⁻²⁷ Indeed, some researchers believe that the most effective intervention in reducing the risk of falling includes review and adjustment of medications.²⁸ Delirium is highly prevalent in the nursing home setting,²⁹ owing to the increased vulnerability of residents due to comorbid conditions, medication

Figure 2. An example of a GRAM RAP-Med report, cont.

Resident: Test Patient		Thursday, June 17, 2004	
RAP #	Name	Medications	RAP Triggers
1	Delirium	Ditropan Plendil temazepam	Altered perception [B5b] Change in behavioral symptoms [E5] Change in cognitive status [B6] Disorganized speech [B5c] Easily distracted [B5a] Lethargy [B5e] Mental function varies over day [B5f] Mood change [E3] Restlessness [B5d]
2	Cognitive Loss/Dementia	Ditropan temazepam	Ability to understand others [C6] Daily decision making [B4] Long term memory [B2b] Short term memory [B2a]
3	Visual Function	Combivent Ditropan Lipitor	Cataracts [I1jj] Decreased peripheral vision [D2a] Glaucoma [I1ll] Vision [D1]
4	Communication	Ditropan temazepam	Ability to understand others [C6] Hearing [C1] Making self understood [C4]

GRAM™ RAP-Med Report

use, infections, electrolyte imbalance, and metabolic disorders. Treatment of delirium is based on the treatment of the precipitating factor, and *prevention plays the most important role*.

Medication Monitoring Care Plans and Flow Records were developed for falls and delirium. In addition to the GRAM RAP-Med reports, the Medication Monitoring Care Plans and Flow Records are generated for newly admitted residents who are receiving medications that may cause, aggravate, or contribute to falls and/or delirium. The Delirium Medication Monitoring Care Plan and Flow Record contain specific MDS items that are “indicators” of delirium and may be caused by adverse medication effects. The Falls Medication Monitoring Care Plan

Figure 3. Admission Medication Monitoring Care Plan—Delirium

FACILITY				
Admission Medication Monitoring CARE PLAN DELIRIUM				
Problem	Short Term Goal	Approach	Monitor	Resp Disc
Risk for Delirium. Resident is receiving medication(s) that may cause, aggravate, or contribute to delirium. Medication(s): (enter from RAP-Med Report) <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	Early recognition of signs, symptoms, and indicators of delirium so problem can be avoided, managed, or reversed.	Observe for new onset or worsening of signs, symptoms, and indicators of delirium every shift x 14 days (or until admission assessment). If new onset or worsening of signs, symptoms, or indicators observed, implement Delirium RAP. Indicators of Delirium: <ul style="list-style-type: none"> EASILY DISTRACTED (B5a)- Difficulty paying attention, difficulty keeping track of what is being said, and/or gets sidetracked easily. PERIODS OF ALTERED PERCEPTION OR AWARENESS OF SURROUNDINGS (B5b)-Moves lips or appears to be talking to someone not present; believes he/she is somewhere else; confuses night and day. EPISODES OF DISORGANIZED SPEECH (B5c)-Speech is incoherent, nonsensical, irrelevant, or rambling from subject to subject; unclear or illogical flow of ideas; unpredictable switching from subject to subject, loses train of thought. PERIODS OF RESTLESSNESS (B5d)- Fidgeting or picking at skin, clothing, napkins, etc.; frequent position changes; repetitive physical movements or calling out. PERIODS OF LETHARGY (B5e)- Sluggishness; staring into space; difficult to arouse; little body movement. MENTAL FUNCTION VARIES OVER THE COURSE OF THE DAY (B5f)- sometimes better, sometimes worse; behaviors sometimes present, sometimes not. Level of consciousness: alert; vigilant (hyperalert), lethargic (drowsy but easily aroused), stupor (difficult to arouse), coma (unarousable). 	Monitor q shift x 14 days or until admission assessment.	
RESIDENT		STATION/ROOM/BED	ADMISSION DATE	
Rev 9-03		AHRQ Study Document		

and Flow Record contain specific MDS items that may be caused by adverse medication effects and contribute to the risk for falls.

As with any system change, training of staff is integral to the successful implementation of new programs. In the first phase of our study, the ASCP Foundation developed and delivered inservice programs for nursing staff of the 13 facilities that received the intervention as part of the AHRQ-funded study. The inservice programs provide detailed information regarding medications that cause, aggravate, or contribute to the risk for falls and delirium; review specific signs and symptoms of adverse medication effects; and reinforce the importance of

early observation for signs and symptoms of adverse medication effects. During the training sessions, facility staff was introduced to the processes of care and provided detailed instruction on how to use the specific reports, care plans, and flow records. Considerable staff turnover in several facilities has required repeat training sessions. For widespread implementation of this intervention, alternative strategies to the delivery of in-service programs need to be explored. We also provided training on GRAM for the consultant pharmacists involved in the project.

Conclusion

In nursing homes, pharmacists must assure that medication use of residents meets the Federal standards as dictated by the OBRA regulations.^{9, 30} Yet, the costs of providing drug regimen review are often bundled into the dispensing costs of medications. There is no systematic form of reimbursement for pharmacists to provide pharmaceutical care beyond the “letter” of the regulations. As such, pharmacists are limited with respect to the time that can be spent on other aspects of pharmaceutical care, including integration of medication monitoring recommendations into the residents’ care plans. Providing such care for all residents may not be feasible; payers are unlikely to pay for this level of pharmacist services for all patients. The use of innovative clinical tools can play an important role in both identifying residents at greatest risk and maximizing pharmacist resources. The GRAM software is an innovative tool to address these pressing needs.

We have demonstrated the feasibility of incorporating a clinical informatics tool into the pharmaceutical care process, with particular focus on the medication monitoring stage. The “real-time” integration of the GRAM software into the commercial pharmacy software for two long-term care pharmacies is complete. The training of both consultant pharmacists and nursing facility staff has been successfully accomplished. The intervention was phased into 13 nursing homes in the fall of 2003, with the full intervention start date on January 1, 2004. Early reports indicate that the GRAM software and monitoring protocols with respect to falls and delirium have been well received and, in one facility, assisted in the CMS certification survey process. Nursing assistants have been receptive to their new medication monitoring responsibilities. After 12 months of intervention delivery, the definitive evaluation of this unique clinical tool will begin. If the GRAM software demonstrates quality improvement, future research must seek, through cost–benefit analysis, to determine the value of the improvement compared with the expense.

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